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Flexible and wearable display technologies are critical to today's dismounted soldiers
By Courtney E. Howard

The U.S. Department of Defense is increasingly investing in the advancement of display technology for military applications. The U.S. Army, in particular, is a driving force in the acceleration of display technology for defense environments.

The Natick Soldier RD&E Center (NSRDEC), located at the U.S. Army Soldier Systems Center in Natick, Mass and working under The Army's Research, Development, and Engineering Command (RDECOM), is focused on outfitting tomorrow's soldiers with the most innovative electronics technologies, including the latest head-mounted displays, as part of the Future Force Warrior (FFW) Science and Technology initiative. Head-mounted displays will provide FFWs with sensor data and a communications link with others on and off the network-centric battlefield.

The Army also is working with the Defense Advanced Research Projects Agency (DARPA) on its Advanced Soldier Sensor Information Systems Technology (ASSIST) effort. ASSIST takes advantage of display technology in combination with soldier-worn sensors, to augment the soldier's situational awareness and to improve his recd and reporting capabilities.

At the same time, the U.S. Army's Warrior programs-including the Land Warrior, Air Warrior, and Mounted Warrior Soldier Systems-integrate a small, helmet-mounted display to deliver command, control, communication and computer (C4) data and video to fielded soldiers. General Dynamics C4 Systems in Scottsdale, Ariz., heads up the Mounted Warrior, Land Warrior, and Air Warrior programs, which are managed by the U.S. Army Program Executive Office-Soldier in Fort Belvoir, Va. General Dynamics C4 Systems contracted Microvision in Redmond, Wash., to provide full-color, helmet-mounted displays for the U.S. Army's Mounted Warrior Soldier System.

Additionally, the Flexible Display Center (FDC), established two years ago as part of a \$43.7 million, five-year agreement between the U.S. Army Research Laboratory (ARL) and Arizona State University, combines the skills and resources of academia, industry, and government to develop thin, light, rugged, and low-power computer screens that are flexible enough to conform to a soldier's sleeve, for example. In February, the FDC announced the world's first flexible, four-inch-diagonal, active-matrix QVGA reflective electrophoretic display fabricated on DuPont Teijin Film's heat-stabilized PEN polyester film. This technology is likely to contribute to the production of display sleeves, flexible printed electronics that form a display on the sleeve of a soldier's uniform.

Display technology is considered to be critical to the Army's network-centric initiatives. "Flexible display technology has the potential to be implemented in a wide variety of applications from command centers, to vehicle platforms, to individual soldiers. It will revolutionize the way in which information is disseminated on the battlefield, increasing both the lethality and survivability of the Future Force," John Miller, then acting director of the U.S. Army Research Laboratory, was quoted as saying in 2004. This statement is no less true today. In fact, flexible and wearable displays are capable of serving a wide variety of military functions - including situational awareness, thermal imaging, simulation and training, and ISR to name a few. "Wearable displays are used in night vision goggles and new command, control, communication, computers, intelligence, surveillance, and reconnaissance (C4ISR), command and control (C2), and weapon systems control applications," Ross Smith, co-founder and president of Quantum3D in San Jose, Calif., acknowledges.

Technology companies are answering the DOD's call for innovative wearable and flexible displays, investing in research and development of rugged, reliable solutions for the soldiers of today and the future. Military personnel are requesting displays with high resolution, low power consumption, small size, and the ability to withstand shock and vibration, and various environment conditions. "Each of these is important, along with cost, color depth, daytime and NVG readability, and life cycle support," Smith notes. "The order of importance depends on the mission. Our customers want super-rugged, multiyear support, small and low-power, in general."

Today's wearable display systems, offered in monocular and binocular form factors, are designed to take up little viewable space. Yet, a new innovation in display technology delivers augmented reality, whereby a head-mounted or wearable display superimposes computer-generated images and information onto a real-world view. As a result, soldiers remain engaged with their environment, while simultaneously benefiting from digitally delivered, real-time operational data delivered on-screen.

Company List		
Add-Vision Inc. 831-438-8192 Scotts Valley, Calif. www.add-vision.com	Kopin Corp. Rugged Solutions Scotts Valley, Calif. 831-430-0688 www.kopin.com	Sensics Inc. Baltimore, Md. 443-927-9200 www.sensics.com
Daeyang E&C Inc. Seoul, South Korea +82-2-3486-0141 www.personaldisplay.com	Liteye Systems Inc. Centennial, Colo. 720-974-1765 www.liteye.com	Shimadzu Precision Instruments Inc. Torrance, Calif. 310-517-9910 www.spi-inc.com www.shimadzu.com
eMagin Bellevue, Wash. 425-749-3600 www.emagin.com	Microvision Inc. Redmond, Wash. 425-936-6847 www.microvision.com	Skyex Pompano Beach, Fla. 954-941-8066 www.skyex.com
Reality.com Inc. San Mateo, Calif. 650-378-8581 www.genreality.com	Nvis Reston, Va. 703-891-1130 www.nvisinc.com	Tek Gear Winnipeg, Canada 204-988-3001 www.tekgear.com
Iculti Corp. Rochester, N.Y. 585-359-5900 www.iculti.com	Optics 1 Inc. Defense Systems Division Manchester, N.H. 603-296-0469 www.optics1.com	Trident Technology Solutions Fairfax, Va. 703-273-1012 www.tridsys.com
i-O Display Systems Sacramento, Calif. 916-928-9639 www.i-glassesstore.com	Oriscap Electronic Co., Ltd Shenzhen, China 86-755-26984125 www.oriscap.com.cn	Trivisio Technologies GmbH Altenrhein, Switzerland +41-71-6667665 www.trivisio.com
InterSense Inc. Bedford, Mass. 781-541-6330 www.isense.com	Rockwell Collins Cedar Rapids, Iowa 319-295-1000 www.rockwellcollins.com	Universal Display Corp. Ewing, N.J. 609-671-0980 www.universaldisplay.com

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